

# Swapnil R. Chhabra

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## Professional Highlights

Results-driven, goal-oriented Biochemical Engineering Professional with broad-based experience and hands-on skill in contemporary R&D operations, advanced analytical and experimental procedures, and the effective support of successful chemical and biochemical engineering efforts. Strong working knowledge of contemporary proteomics and genomics technologies, leading edge biochemical engineering systems, and sophisticated experimental design and analysis techniques. Acknowledged for being resourceful, adaptable, and self-directed with the ability to meet even the most challenging goals due to outstanding troubleshooting, analytical, and problem solving skills. Exceptional ability to concurrently manage complex, multi-step research and development oriented projects while meeting rigorous procedural standards, tight time-frames, and strict operational protocols. Excellent project management, interpersonal and business communication skills with the experience required to remain highly focused and exceptionally productive in fast-paced, high-pressure environments.

## Education

- Postdoctorate, Functional Genomics, 2003~2005, Sandia National Laboratory – Livermore, CA.
- Ph.D., Chemical Engineering, 2002, North Carolina State University – Raleigh, NC.
- M.S., Chemical Engineering / Minor in Biotechnology, 1999, NC State University – Raleigh, NC.
- B.S., Chemical Engineering, 1997, University Institute of Chemical Technology – Mumbai, India.

## Professional Experience

- **Joint BioEnergy Institute**, Emeryville, California. 2007 ~ Present.  
Director, Organism Engineering Group, Fuel Synthesis Division.
  - **Design and Development of Engineered Mesophilic and Thermophilic Host Microbes for Consolidated Bioprocessing of Lignocellulosic Biomass:** Research Focus: Use of Synthetic Biology principles and Rational Metabolic Engineering approaches for engineering model organisms *Escherichia coli* and *Sulfolobus acidocaldarius* for biofuel applications.
  - **Evolutionary Engineering for generating Enhanced Host Microbes for Biofuel Applications:** Research Focus: Use of combinatorial approaches such as Whole-Genome-Shuffling for engineering model organisms *E. coli* and *Saccharomyces cerevisiae* in conjunction with Functional Genomics tools for systematic characterization of microbial evolution.
- **Lawrence Berkeley National Laboratory**, Berkeley, California. 2006 ~ Present.  
Scientist, Physical Biosciences Division.
  - **Protein Complex Analysis Project (PCAP):** Research Focus: Development of novel high throughput strategies for enabling rapid identification of protein-protein interactions in the model sulfate reducer *Desulfovibrio vulgaris*. The resulting interactions would be used for generating a dynamic network map (interactome) of this microbe.

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## **Professional Experience (contd.)**

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## Professional Experience (contd.)

- **North Carolina State University**, Raleigh, North Carolina. 1997 ~ 1999.  
**Graduate Teaching Assistant**, Chemical Engineering Department.
  - Delivered lectures, tutored students, participated in laboratory exercises, and graded course material several specialized courses that included Chemical Process Principles, Transport Processes, and Process Control.
  - Created a positive learning atmosphere, with an emphasis on creating an environment where students learned to succeed through cooperative and collaborative efforts.
  - Developed a comprehensive solutions manual for instructors “*Elementary Principles of Chemical Processes (Wiley Series in Chemical Engineering)*” R.M. Felder and R.W. Rousseau, 3rd ed. 1999.
- **Hindustan Petroleum Corporation Limited**, Mumbai Refinery, India. 1996.  
**In-plant Trainee**, Unit Operations Division.
  - Provided process design support and engineering services while serving on the Technical Services Team for India’s second largest oil refinery.

## Awards

- **Sandia National Laboratories Team Recognition Award**, 2005:  
The Bio Micro Fuel Cell (BμFC) Team for exceptional teamwork and creativity in developing new technologies for sustainable micro-scale power sources powered by carbohydrate fuels.

## Publications

1. **S.R. Chhabra**, K. N. Parker, D. Lam, W. Callen, M. A. Snead, E.J. Mathur, J.M. Short and R.M. Kelly, “*β-Mannanases from Thermotoga spp.*” 2001. *Method Enzymol.* 330:224-238.
2. K.N. Parker, **S.R. Chhabra**, D. Lam, W. Callen, M. A. Snead, E.J. Mathur, J.M. Short and R.M. Kelly, “*β-Mannosidase from Thermotoga spp.*” 2001. *Method Enzymol.* 330:238-246.
3. K.N. Parker, **S.R. Chhabra**, D. Lam, W. Callen, M. A. Snead, E.J. Mathur, J.M. Short and R.M. Kelly, “*Galactomannanases Man2 and Man5 from Thermotoga species: Growth physiology on galactomannans, gene sequence analysis and biochemical properties of recombinant enzymes*” 2001. *Biotechnol Bioeng.* 75:322-333.
4. **S.R. Chhabra**, K.R. Shockley, D.E. Ward and R.M. Kelly, “*Regulation of endo-acting glycosyl hydrolases in the hyperthermophilic bacterium Thermotoga maritima grown on glucan- and mannan- based polysaccharides*” 2002. *Appl. Environ. Microbiol.* 68:545-554.

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## Publications (contd.)

5. **S.R. Chhabra** and R.M. Kelly, "Biochemical characterization of *Thermotoga maritima* endoglucanase Cel74 with and without a carbohydrate binding module (CBM)." 2002. *FEBS Lett.* 531: 375-380.
6. K.R. Shockley, D.E. Ward, M.A. Pysz, **S.R. Chhabra**, S.B. Conners and R.M. Kelly, "Regulation of proteolysis in hyperthermophilic microorganisms" 2002. *Abstr. Pap. Amer. Chem. Soc.* 224: 034-BIOT.
7. **S.R. Chhabra**, K.R. Shockley, S.B. Conners, K. Scott, R.D. Wolfinger and R.M. Kelly, "Carbohydrate-induced differential gene expression patterns in the hyperthermophilic bacterium *Thermotoga maritima*" 2003. *J. Biol. Chem.* 278: 7540-7552.
8. K. R. Shockley, D.E. Ward, **S.R. Chhabra**, S.B. Burns, C.I. Montero and R. M. Kelly, "Differential expression of stress, protease and glycosidase genes in the hyperthermophilic archaeon *Pyrococcus furiosus* during heat shock from 90-105°C" 2003. *Appl. Environ. Microbiol.* 69: 2365-2371.
9. **S.R. Chhabra**, K. R. Shockley, S. B. Conners, K. Scott, R. D. Wolfinger and R. M. Kelly, "Glycoside Hydrolases from the Hyperthermophilic Bacterium *Thermotoga maritima*: Physiological & Biotechnological Aspects" 2003. *Abstr. Pap. Amer. Chem. Soc.* 225: 109-BIOT.
10. M.A. Pysz, C.I. Montero, **S.R. Chhabra**, R.M. Kelly and K.D. Rinker, "Significance of Polysaccharides in Microbial Physiology and the Ecology of Hydrothermal Vent Environments" 2004. *Geophysical Monograph Series: The Subsurface Biosphere at Mid-Ocean Ridges.*
11. D.A. Comfort, **S.R. Chhabra**, S.B. Conners, C-J Chou, K.L. Epting, M.R. Johnson, K.L. Jones, A.C. Sehgal and R.M. Kelly, "Strategic Biocatalysis with Hyperthermophilic Enzymes" 2004. *Green Chem.* 9: 459-465.
12. S.B. Conners, C.I. Montero, D.A. Comfort, K.R. Shockley, M.R. Johnson, **S.R. Chhabra** and R.M. Kelly, "Prediction of carbohydrate transport and utilization regulons in the hyperthermophilic bacterium *Thermotoga maritima* through the use of carbohydrate-specific transcriptional response". 2005. *Abstr. Pap. Amer. Chem. Soc.* 229: 387-BIOT.
13. D.Yu, J.V. Volponi, **S.R. Chhabra**, J.C. Brinker, A. Mulchandani and A.K. Singh, "Aqueous sol-gel encapsulation of genetically engineered *Moraxella* sp. cells for the detection of organophosphates" 2005. *Biosens. Bioelect.* 20 (7): 1433-1437.
14. S. Pathak, B.A. Simmons, **S. R. Chhabra**, J. R. McElhanon and P. M. Dentinger, "Surface Patterning of Gram Positive and Gram Negative Bacterial Cells Using a Small Hydrophobic Molecule" 2005. *Sensor Lett.* 3(2): 157-160.
15. S.M. Burns, C.I. Montero, M.R. Johnson, D.A. Comfort, K.R. Shockley, **S.R. Chhabra** and R.M. Kelly, "An expression driven approach to the prediction of carbohydrate transport and utilization regulons in the hyperthermophilic bacterium *Thermotoga*

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## Publications

(contd.)

- maritima.*" 2005. *J. Bacteriol.* 187:7267-7282.
16. **S.R. Chhabra**, Q. He, K.H. Huang, S.P. Gaucher, E.J. Alm, Z. He, M.Z. Hadi, T.C. Hazen, J.D. Wall, J. Zhou, A.P. Arkin and A.K. Singh, "Global Analysis of Heat Shock Response in *Desulfovibrio vulgaris Hildenborough*." 2006. *J. Bacteriol.* 188: 1817-1828.
  17. Fortman, J.L.\*, **S. Chhabra\***, A. Mukhopadhyay, H. Chou, T.S. Lee, E. Steen, and J.D. Keasling, "Biofuel Alternatives to Ethanol: Pumping the Microbial Well." 2008. *Trends Biotechnol.* 26(7): 375-381.
  18. **S.R. Chhabra** and J.D. Keasling, "Metabolic Design and Control for Production in Prokaryotes." 2009. *Comprehensive Biotechnology*. Submitted.
  19. **S.R. Chhabra<sup>∞\*</sup>**, M. Joachimiak\*, C. Petzold, G. Zane, M.N. Price, S. Gaucher, A.K. Singh, B-G Han, O-Y Fok, P. Hwu, D. Elias, M. Singer, J-M. Chandonia, D. Joyner, T.C. Hazen, A.P. Arkin, J.D. Wall and J. D. Keasling<sup>∞</sup>, "A Network of Protein-Protein Interactions and a Revised Bioenergetic Model of the Model Sulfate Reducer *Desulfovibrio vulgaris Hildenborough*." *Genome Biology*. 2009 (To Be Submitted).
  20. **S. R. Chhabra<sup>∞\*</sup>**, G. Butland\*, D. Elias\*, J-M. Chandonia, K. Keller, O-Y Fok, T. Juba, R. Prathapam, M. Ouellet, S. Allen, E. Witkowska, M. Singer, T.C. Hazen, J.D. Wall<sup>∞</sup>, M.D. Biggin<sup>∞</sup> and J. D. Keasling, "Generalized Schemes for High Throughput Manipulation of Bacterial Genomes." 2009 (in preparation).

\* Equally contributing author. ∞ Corresponding author.

## Pending Patents

1. S.A. Khan, R.M. Kelly, R.K. Prud'homme, M.D. Burke, Y. Cheng and **S.R. Chhabra**, "Controlled Enzymatic Degradation of Guar Galactomannan Solutions using Enzyme Inhibition" Pub. No. US 2002/0193343 A1: 2002. Patent Pending.
2. **S.R. Chhabra**, J.M. Cintron, R. Shediac, "Methods and devices for Protein Assays" Application# 11/239387. 2005. Patent Pending.

## Presentations

1. **S.R. Chhabra** (presenter), G. Butland, D. Elias, V. Fok, B. Gold, J. Jin, A. Mukhopadhyay, R. Prathapam, W. Yang, J-M Chandonia, J. Wall, T. Hazen, and J. Keasling. "High Throughput Strategies For Tagged-Strain Generation In *Desulfovibrio vulgaris*" Joint Genomics: GTL Awardee Workshop V and Metabolic Engineering, 2008 and USDA-DOE Plant Feedstock Genomics for Bioenergy Awardee Workshop 2008, Washington, DC.
2. M.N. Price, Y. J. Tang, P. I. Benke, E. E. Baidoo, **S. R. Chhabra**, On-Yi Fok, S. Myers, C.J. Petzold, P.S. Dehal, A. Mukhopadhyay, G.M. Zane, J.D. Wall, Jay D. Keasling and Adam P. Arkin, "Identification of amino acid synthesis pathways in *Desulfovibrio vulgaris* by isotopic labeling, metabolite analysis, and genome sequence analysis" May 2008, Boston, MA. Annual Meeting American Society for Microbiology.

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## Presentations (contd.)

3. **S.R. Chhabra** (presenter), A. Mukhopadhyay, G. Zane, C. Hemme, J. Zhou, J. Wall, T. C. Hazen, and J. Keasling. "Functional Characterization of the *Desulfovibrio vulgaris Hildenborough* Megaplasmid." May 2007, Toronto, Canada. Annual Meeting American Society for Microbiology.
4. **S.R. Chhabra** (presenter), G. Butland, D. Elias, A. Mukhopadhyay, J. M. Chandonia, J. Wall and J.D. Keasling. "Protein Complex Analysis Project (PCAP): High Throughput Strategies For Tagged-Strain Generation In *Desulfovibrio vulgaris*." Joint Genomics: GTL Awardee Workshop V and Metabolic Engineering, 2007 and USDA-DOE Plant Feedstock Genomics for Bioenergy Awardee Workshop 2007, Washington, DC.
5. Elias, D., **S.R. Chhabra**, J. T. Geller, H.-Y. N. Holman, D. Joyner, J. Keasling, A. Mukhopadhyay, M. Singer, T. Torok, J. Wall, T. C. Hazen, G. Butland, M. Dong, S. C. Hall, B. K. Jap, J. Jin, S. J. Fisher, P. J. Walian, H. E. Witkowska, L. Yang, M. D. Biggin\*, M. Auer, A. Avila-Sakar, F. Garczarek, R. M. Glaeser, J. Malik, E. Nogales, H. Palsdottir, J. P. Remis, D. Typke, K. H. Downing, S. S. Andrews, A. P. Arkin, S. E. Brenner, Y. W. Huang, J. Jacobsen, K. Keller, R. Santos, M. Shatsky, and J.-M. Chandonia. "Protein Complex Analysis Project (PCAP): Project Overview." February 2007, North Bethesda, MD. Joint Genomics: GTL Awardee Workshop V and Metabolic Engineering 2007 and USDA-DOE Plant Feedstock Genomics for Bioenergy Awardee Workshop 2007. LBNL 62471.
6. Hazen, T. C., H.-Y. N. Holman, J. Keasling, A. Mukhopadhyay, **S.R. Chhabra**, J. T. Geller, M. Singer, D. Joyner, T. Torok, J. Wall, D. Elias and M. D. Biggin. "Protein Complex Analysis Project (PCAP): High Throughput Identification and Structural Characterization of Multi-Protein Complexes During Stress Response in *Desulfovibrio vulgaris*: Microbiology Subproject." February 2007, North Bethesda, MD. Joint Genomics: GTL Awardee Workshop V and Metabolic Engineering 2007 and USDA-DOE Plant Feedstock Genomics for Bioenergy Awardee Workshop 2007. LBNL 62472.
7. **S.R. Chhabra**, S. Gaucher (presenter), G. Zane, E. L. Alm, A. P. Arkin, T. C. Hazen, J. D. Wall, and A. Singh. "Investigation of Protein-Protein Interactions in the Metal-Reducing Bacterium *Desulfovibrio vulgaris*." May 2006, Orlando, FL. American Society for Microbiology Annual Meeting.
8. Hazen, T. C., H.-Y. N. Holman, J. Keasling, A. Mukhopadhyay, **S.R. Chhabra**, T. Torok, J. D. Wall, and M. D. Biggin. "Protein Complex Analysis Project (PCAP): High Throughput Identification and Structural Characterization of Multi-Protein Complexes during Stress Response in *Desulfovibrio vulgaris*: Microbiology Subproject." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.
9. Biggin, M. D., D. Elias, **S.R. Chhabra**, H.-Y. Holman, J. Keasling, A. Mukhopadhyay, T. Torok, J. Wall, T. C. Hazen, M. Dong, S. Hall, B. K. Jap, J. Jin, S. Fisher, P. J. Walian, H. E. Witkowska, M. Auer, R. M. Glaeser, J. Malik, J. P. Remis, D. Typke, K. H. Downing, A. P. Arkin, S. E. Brenner, J. Jacobsen, and J.-M. Chandonia. "Protein Complex Analysis Project (PCAP): High Throughput Identification and Structural

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## Presentations (contd.)

Characterization of Multi-Protein Complexes during Stress Response in *Desulfovibrio vulgaris*: Project Overview." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.

10. Wall, J. D., H.-C. Yen, E. C. Drury, A. Mukhopadhyay, **S.R. Chhabra**, Q. He, M. W. Fields, A. Singh, J. Zhou, T. C. Hazen, and A. P. Arkin. "Evaluation of stress responses in sulfate-reducing bacteria through genome analysis: Identification of universal responses." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.
11. Mukhopadhyay, A., E. J. Alm, A. P. Arkin, E. E. Baidoo, P. I. Benke, S. E. Borglin, W. Chen, **S.R. Chhabra**, M. W. Fields, S. P. Gaucher, A. Gilman, M. Hadi, T. C. Hazen, Q. He, H.-Y. Holman, K. Huang, R. Huang, Z. He, D. C. Joyner, M. Keller, K. Keller, P. Oeller, F. Pingitore, A. Redding, A. Singh, D. Stahl, S. Stolyar, J. Sun, Z. Yang, J. D. Wall, G. Zane, J. Zhou, and J. D. Keasling. "VIMSS Functional Genomics Core Research on Stress Response Pathways in Metal-Reducers." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.
12. Gaucher, S., M. Hadi, **S.R. Chhabra**, E. Alm, G. Zane, D. C. Joyner, A. P. Arkin, T. C. Hazen, J. D. Wall, and A. Singh. "Investigation of Protein-Protein Interactions in the Metal-Reducing Bacterium *Desulfovibrio vulgaris*. VIMSS Functional Genomics Core Research on Stress Response Pathways in Metal-Reducers." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.
13. Alm, E. J., E. E. Baidoo, P. I. Benke, S. E. Borglin, W. Chen, **S.R. Chhabra**, M. W. Fields, S. P. Gaucher, A. Gilman, M. Hadi, T. C. Hazen, Q. He, H.-Y. Holman, K. Huang, R. Huang, Z. He, D. C. Joyner, J. D. Keasling, M. Keller, K. Keller, A. Mukhopadhyay, P. Oeller, F. Pingitore, A. Redding, A. Singh, D. Stahl, S. Stolyar, J. Sun, Z. Yang, J. D. Wall, G. Zane, J. Zhou, and A. P. Arkin. "Comparative Analysis of Bacterial Gene Expression in Response to Environmental Stress." February 2006, Washington, DC. DOE Genomics:GTL Annual Workshop.
14. **S. Chhabra** (presenter), Q. He, Z. He, S. Gaucher, E. Alm, A. Arkin, M. Hadi, T. Hazen, J. Zhou and A. Singh, "Analysis of the Heat Shock Response in *Desulfovibrio vulgaris* through Global Proteomics and Transcriptomics Studies" ASM General Meeting Jun5~9, 2005, Atlanta, GA.
15. S.P. Gaucher, **S.R. Chhabra**, M.Z. Hadi and A.K. Singh, "Identification and Characterization of Proteins Involved with Stress Response in *Desulfovibrio vulgaris*" 52nd ASMS Conference, May23-27, 2004, Nashville, TN.
16. **S.R. Chhabra** (presenter), S.P Gaucher, M.Z. Hadi and A.K. Singh, "Heat shock response in *Desulfovibrio vulgaris*: A proteomics study" 5th International Symposium on the Interface Between Analytical Chemistry and Microbiology, Pacific Northwest National Laboratory (PNNL), Apr 19-Apr 21, 2004, Richland, WA.
17. J. Keasling (speaker), S. Brown, **S. Chhabra**, B. Emo, W. Gao, S. Gaucher, M. Hadi, Q. He, Z. He, T. Li, Y. Liu, V. Martin, A. Mukhopadhyay, A. Redding, J. Ringbauer Jr., D.

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## **Presentations (contd.)**

Stanek, J. Sun, L. Sun, J. Wei, L. Wu, H- C. Yen, W. Yu, G. Zane, M. Fields, M. Keller, A. Singh, D. Thompson, J. Wall and J. Zhou, "VIMSS Functional Genomics Core: Analysis of Stress Response Pathways in Metal-Reducing Bacteria" Department of Energy (DOE): Genomes to Life Contractor (GTL)-Grantee Workshop II, Feb 29-Mar 2, 2004, Washington, DC.

18. **S.R. Chhabra** (speaker), K. R. Shockley, S. B. Conners, K. Scott, R. D. Wolfinger and R. M. Kelly, "Glycoside Hydrolases from the Hyperthermophilic Bacterium *Thermotoga maritima*: Physiological & Biotechnological Aspects" ACS 225th Spring National Meeting, Mar 23-Mar 27, 2003, New Orleans, LA.
19. K.R. Shockley (speaker), D.E. Ward, M.A. Pysz, **S.R. Chhabra**, S.B. Conners and R.M. Kelly, "Regulation of proteolysis in hyperthermophilic microorganisms" ACS 224th Fall National Meeting, Aug 18-Aug 22, 2002, Boston, MA.
20. **S.R. Chhabra** (speaker) and R.M. Kelly, "Hyperthermophilic Glycosidases: Hydrolysis to Synthesis", Schoenborn Award Competition, November 27, 2001, Raleigh, NC.
21. **S.R. Chhabra** (speaker), K.R. Shockley and R.M. Kelly, "Biochemical and Biophysical characterization of hyperthermophilic glycosidases Cel5A and Man5", Seventh Annual Hyperthermophile Symposium, October 25-27, 2000, Raleigh, NC.
22. **S.R. Chhabra** (speaker) and R.M. Kelly, "Biochemical and Biophysical characterization of hyperthermophilic glycosidases Cel5A and Man5 from *Thermotoga maritima*", Sixth Annual Hyperthermophile Symposium, May 19-21, 1999, Athens, GA.
23. R.M. Kelly (speaker), J. Gao, K.N Parker, S.G. Cady and **S.R. Chhabra**, "Hyperthermophilic  $\beta$ -glycosidases: What the genome sequences tell us", Mar 10-12, 1999, IBC International Congress on Enzyme Technologies, San Francisco, CA.

## **Affiliations**

- American Society for Microbiology
- American Chemical Society

## **References**

Available upon request.